Determine Abundances were determined 40 One short (.4 20 Core shows similar trend as Sand Lake 20 Over time, nutrient levels within the lakes have increased due 20 Live diatoms were sampled using a 20 Utilize satellite lakes to determine potential nutrient inputs from groundwater Varying between 40 Down core shows increases in productivity 20 Diatom responds first to this P , and aquatic vegetation takes over, tying up 20 Analyze nutrient cycling through entire system 20 Use diatoms to track pollution spatially, and chronologically, back to its source 20 Samples were analyzed from the six 20 Lake system moves from 20 Slides are counted to 300,

Benthic Diatoms

3.1 More recent times suggest a general increase in available nutrients. 20 Microscope slides were made 20 Agricultural area in close proximity 60 Hydrogen peroxide was added 40 Gomphonema truncatum 40 80 40

Dock Lake

- Core shows similar trend as Sand Lake
- Lake system moves from mesotrophic-eutrophic
- Stephanodiscus abundances also show an increase in available P within the Dock Lake system

Sand Lake

- Sand Lake shows a relatively stable past.
- Varying between mesotrophic and oligotrophic.
- More recent times suggest a general increase in available nutrients.
- Stephanodiscus abundances also suggest an increase in P within the system.

Conclusions
- Weber, Sand, and Dock Lake were once an oligotrophic-mesotrophic system.
- Over time, nutrient levels within the lakes have increased due to possible input from agricultural activities.
- High P diatoms become abundant during the most recent years due to a possible contribution from the on-site correction facility.
- Dock Lake has maintained low-normal nutrient levels, but recently switched to acting more like a stream system than a lake.

Future Work
- Collect a Livingstone Core from Long Lake
- Count remaining cores
- Date three, or more, cores
- Analyze nutrient cycling through entire system
- Analyze if P pollution is coming from on-site facilities
- Analyze long core to determine the pre-settlement system
- Determine groundwater influence

Acknowledgements
- The Indiana Division of State Parks & Reservoirs
- ISU Paleolimnology Lab
- Field assistance: Alan McCune, Sabrina Brown, Cory Portwood
- Lab assistance: Shanai Shepard

Previous Research

- Stephan Abundance vs. Distance From Possible Source
- Slides were sieved, and charcoal counted to 300.
- Live diatoms were sampled using a plankton net.
- Samples were analyzed from the six westernmost lakes.
- Samples showed decreasing levels of diatoms that are indicative of higher phosphorus progressively westward.
- Agricultural area in close proximity to two westernmost lakes caused increases in phosphorus.

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Tracking Eutrophication through a Series of Kettle Lakes in Agricultural Indiana
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Abstract

Clair O’ Lakes State Park, located in northern Indiana, consists of nine interconnected lakes and four satellite lakes, with depths that range from 1-20 m. Clair O’ Lakes State Park is bordered to the north, east, and south by farmlands, and a correctional facility in the eastern-most section of the park. Park managers have reported increasing cyanobacteria blooms throughout last decade, which has resulted in periodic closure of recreational facilities. Park managers are concerned about the impact on the lake ecosystems and tourism to the park.

Our project is designed to explore the impact of eutrophication through a chain of interconnected lakes, and the impacts of development and agriculture on the system through time. We will be analyzing diatom assemblages from short cores from each lake in the system. One long core will be taken from Long Lake in order to establish a long-term baseline nutrient level for the lake systems. We intend to compare the timing of eutrophication within individual systems to explore the influence of lake hierarchy on nutrient cycling in a flow-through system. We will also attempt to track nutrients through the interconnected lake system to determine if the corrections facility is a point source for contamination.

Methods

FIELD WORK
- One short (4-12 cm) core was taken from each of the nine lakes, and one from a satellite lake

LAB WORK
- Cores sampled every 5cm, and weighed before, and after drying.
- Hydrogen peroxide was added to remove organic content.
- Abundances were determined by adding microspheres.
- Microscope slides were made using Bouchard mounting media.
- Slides are counted to 300, unless abundances are low.
- Long core samples will also be sieved, and charcoal counted to determine the introduction of humans on the landscape.

Weber Lake

- Weber Lake shows a relatively stable, mesotrophic past.
- Around 10 cm, a spike in Stephanodiscus suggests an influx of available P.
- Diatom responds first to this P, and aquatic vegetation takes over, tying up much of the available P.
- Productivity drops as macrophytes take over, and is slowly on the rise.

Sand Lake

- Sand Lake shows a relatively stable past.
- Varying between mesotrophic and oligotrophic.
- More recent times suggest a general increase in available nutrients.
- Stephanodiscus abundances also suggest an increase in P within the system.

Sucker Lake

- Core shows slight signs of eutrophication
- Down core shows increases in productivity
- Recent times suggest a shift from lake like conditions to stream like conditions within the lake
- This could be caused by inflowing or, more likely, change in light penetration

Objectives

1. Determine lag times between introduction of nutrients between lakes
2. Utilize lake characteristics (such as depth, etc) to determine hierarchy of nutrient cycling controls
3. Use diatoms to track pollution spatially, and chronologically, back to its source
4. Utilize satellite lakes to determine potential nutrient inputs from an external source
5. Determine long-term baseline nutrient levels to quantify the significance of anthropogenic influence from pre-Native American colonization through modern settings

# Table of Diatoms

<table>
<thead>
<tr>
<th>Planktonic Diatoms</th>
<th>Benthic Diatoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stephanodiscus hantzchii</td>
<td>Gomphonema truncatum</td>
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<tr>
<td>Stephanodiscus minutulus</td>
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<tr>
<td>Aulacoseira ambigua</td>
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<td>Aulacoseira granulata</td>
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<tr>
<td>Stephanodiscus (sum)</td>
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<tr>
<td>Fragilaria (sum)</td>
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